

We claim.

- 1 A thermoreversible polymer gel composition having a Shore A hardness less than 30 comprising
 - a. a co-polymer having at least 1 block selected from a vinyl-substituted aromatic hydrocarbon, a R^1R^2 ethylene, and an alkyl vinyl ether, and at least one additional block containing maleimide contributed monomer units,
 - b. an extender,
 - c. at least one metal oxide filler,
 - d. a maleated polyalkylene, and
 - e. a grafting agent
- 2 The composition of claim 1 wherein said vinyl-substituted aromatic hydrocarbon is chosen from any one or combination of styrene, α -methylstyrene, 1-vinylnaphthalene, 2-vinyl-naphthalene, 1- α -methylvinylnaphthalene, 2- α -methyl vinylnaphthalene, as well as alkyl, cycloalkyl, aryl, alkaryl, and aralkyl derivatives thereof, in which the total number of carbon atoms in the combined hydrocarbon is generally not greater than 18, as well as any di- or tri-vinyl-substituted aromatic hydrocarbons
- 3 The composition of claim 2 wherein said vinyl-substituted aromatic hydrocarbon is styrene
- 4 The composition of claim 1 wherein said R^1R^2 ethylene is one or more of ethylene, propylene, butylene, isobutylene, pentene, hexene, and heptene

5. The composition of claim 4 wherein said R¹R²ethylene is isobutylene

6. The composition of claim 1 wherein said alkyl vinyl ether is one or more of methyl vinyl ether, ethyl vinyl ether, propyl vinyl ether, butyl vinyl ether, pentyl vinyl ether, hexyl vinyl ether, and an alkyl vinyl ether with up to 20 carbon atoms in the alkyl substituent.

7. The composition of claim 1 wherein said R¹ and R² groups of the R¹R² ethylene and the alkyl groups of said alkyl vinyl ether are independently chosen from one or more of methyl, ethyl, propyl, isopropyl, butyl, isobutyl, pentyl, isopentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, cyclopropyl, 2, 2-dimethylcyclopropyl, cyclopentyl, cyclohexyl, methoxymethyl, methoxypropyl, methoxybutyl, methoxypentyl, methoxyhexyl, methoxyheptyl, methoxyoctyl, methoxynonyl, methoxydecyl, ethoxymethyl, ethoxyethyl, ethoxypropyl, ethoxybutyl, ethoxypentyl, ethoxyhexyl, ethoxyheptyl, ethoxyoctyl, ethoxynonyl, ethoxydecyl, propoxymethyl, propoxyethyl, propoxypropyl, propoxybutyl, propoxypentyl, propoxyhexyl, propoxyheptyl, propoxoctyl, propoxynonyl, propoxydecyl, butoxybutoxymethyl, butoxyethyl, butoxypropyl, butoxybutyl, butoxypentyl, butoxyhexyl, butoxyheptyl, butoxyoctyl, butoxynonyl, butoxydecyl, pentyloxymethyl, pentyloxyethyl, pentyloxpropyl, pentyloxybutyl, pentyloxypentyl, pentyloxyhexyl, pentyloxyoctyl, pentyloxyynonyl, pentyloxydecyl, hexyloxymethyl, hexyloxyethyl, hexyloxypropyl, hexyloxybutyl, hexyloxpentyl, hexyloxyhexyl, hexyloxyheptyl, hexyloxyoctyl, hexyloxyynonyl, hexyloxydecyl, heptyloxymethyl, heptyloxyethyl, heptyloxypropyl,

heptyloxybutyl, hexyloxpentyl, heptyloxyhexyl, heptyloxyheptyl,
heptyloxyoctyl, heptyloxynonyl, heptyloxydecyl, octyloxymethyl, octyloxyethyl,
octyloxypropyl, octyloxybutyl, octyloxpentyl, octyloxyhexyl, octyloxyheptyl,
octyloxynonyl, octyloxyoctyl, decyloxymethyl, decyloxyethyl, decyloxypropyl,
decyloxybutyl, decyloxpentyl, decyloxyhexyl, decyloxyheptyl, 1-methylethyl, 1-
methylpropyl, 1-methylbutyl, 1-methylpentyl, 1-methyhexyl, 1-methylheptyl, 1-
methyloctyl, 1-methylnonyl, 1-methyldecyl, 2-methylpropyl, 2-methylbutyl, 2-
methylpentyl, 2-methylhexyl, 2- methylheptyl, 2-methyloctyl, 2, 3-dimethylbutyl,
2, 3, 3-trimethylbutyl, 3-methylpentyl, 2, 3-dimethylpentyl, 2, 4-dimethylpentyl,
2, 3, 3, 4-tetramethylpentyl, 3-methylhexyl, 2, 5-dimethylhexyl, and the like

8. The composition of claim 1 wherein said maleimide is the reaction product of maleic anhydride and a mono-primary amine.
9. The composition of claim 8 wherein said mono-primary amine is octyl amine
10. The composition of claim 1 wherein said extender comprises at least about 10% of the composition
11. The composition of claim 10 wherein said extender is a di(tridecyl) phthalate oil
12. The composition of claim 1 wherein the monomer from which the alkylene moiety of said maleated polyalkylene is derived from at least one of ethylene and propylene

13. The composition of claim 1 wherein said grafting agent comprises at least one of primary amines, secondary amines, carboxyl, formyl, and hydroxyl.

14. The composition of claim 1 wherein said grafting agent is a diamine

15. The composition of claim 1 wherein said metal oxide filler comprises at least one of ZnO, TiO₂, BaTiO₃, Fe₂O₃, and mixtures thereof.

16. The composition of claim 1 wherein said metal oxide filler has a particle size less than about 15 µm

17. The composition of claim 1 wherein said metal oxide filler comprises between about 0.1 and 40 wt% of the final composition.

18. A method for forming a thermoreversible polymer gel composition having a Shore A hardness less than 30 and a service temperature up to about 145 °C comprising mixing together:

- a a copolymer having at least 1 block selected from a vinyl-substituted aromatic hydrocarbon, a R¹R²ethylene, an alkyl vinyl ether, and at least one additional block containing maleimide contributed monomer units,
- b an extender,
- c at least one metal oxide filler,
- d a maleated polyalkylene, and
- e a grafting agent

19 A method of claim 18 wherein said metal oxide filler comprises at least one of ZnO, TiO₂, BaTiO₃, Fe₂O₃, and mixtures thereof.

20 The method of claims 18 wherein said metal oxide filler comprises between about 0.1 and 40 wt% of the final composition

If any of these cells have their boundaries